Effects of ionizing radiation on the chemical and isotopic composition of the geologic outcrops on Mars.

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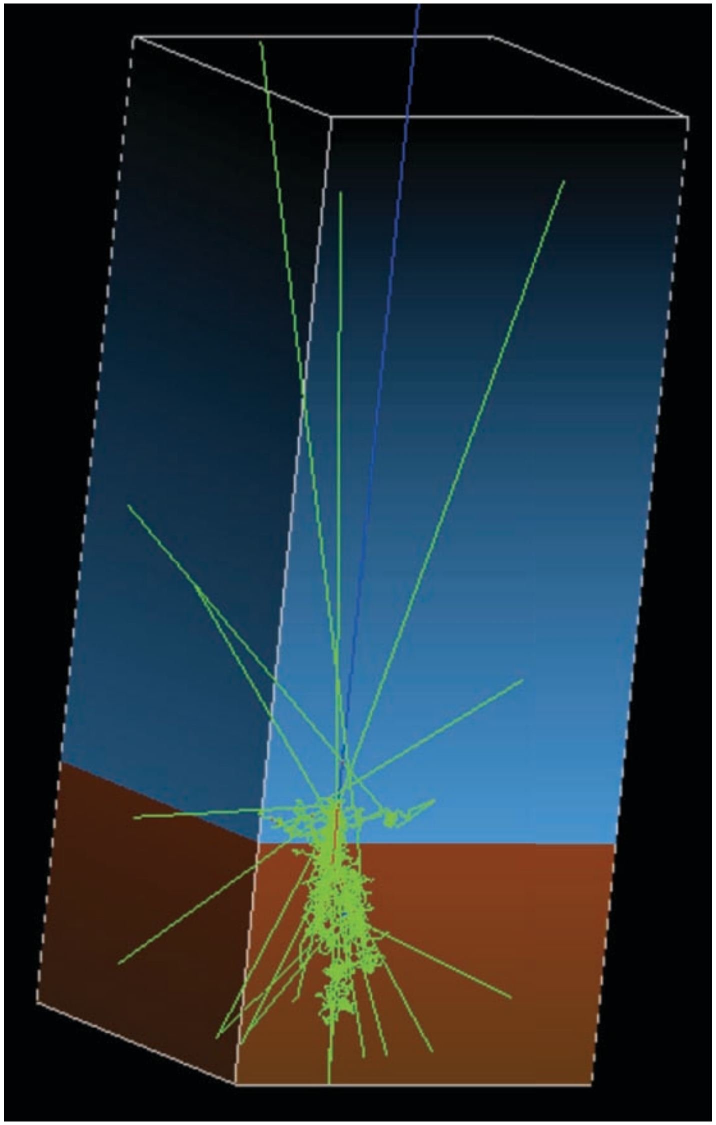
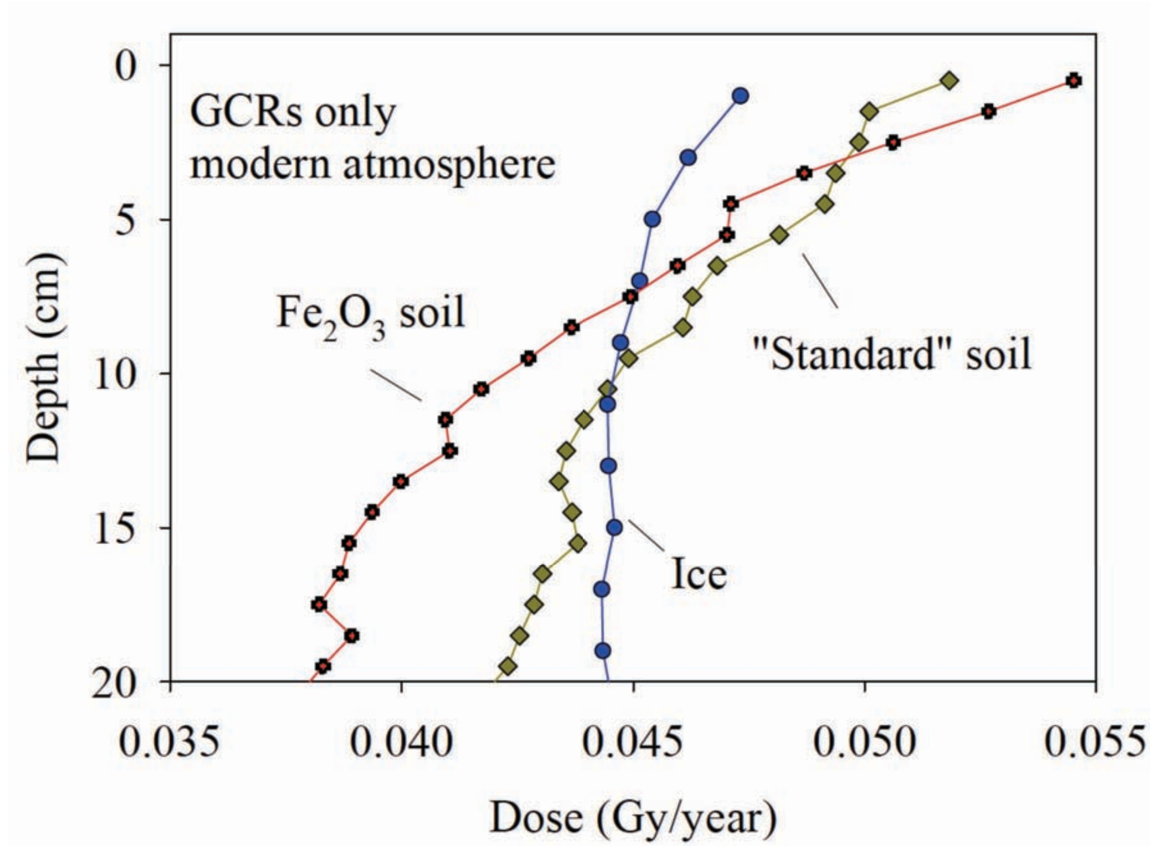
Ionizing radiation

- **Ionizing radiation:** GCR and SCR. GCR higher energies, does not change much. SCR up to 100s MeV, highly variable. Lya photon ~10 eV
- **Ionizing radiation:** is usually ignored because the the total energy of Solar UV is ~10000 times higher than the total energy of the cosmic rays
- **Ionizing radiation:** reached the Martian surface for **billions** of years due to thin Martian atmosphere and lack of magnetic filed.
- **Ionizing radiation:** penetrates down to ~1 m into the solid rock (**unlike UV** and atmospheric oxidants)




GCRs only
modern atmosphere
Fe_2O_3 soil
"Standard" soil
Ice
Depth (cm)
0
5
10
15
20
0.035
0.040
0.045
0.050
0.055
Dose (Gy/year)

[illegible]

[illegible]

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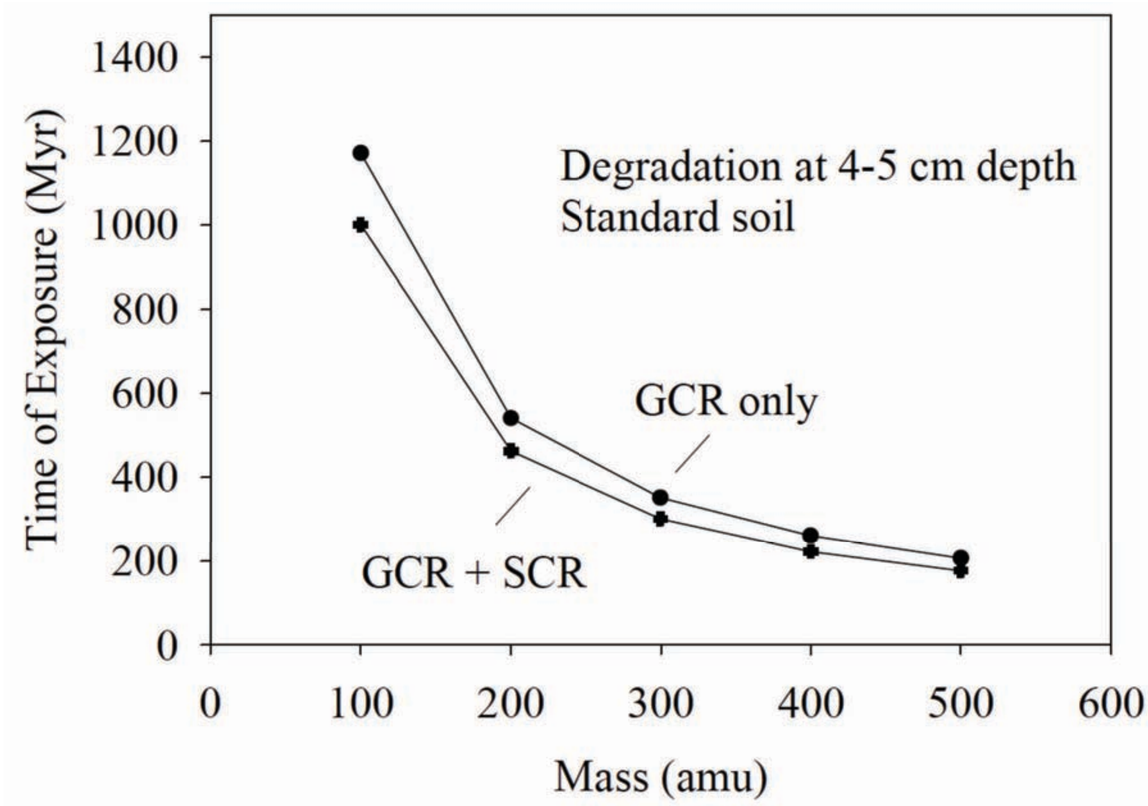
Degradation at 4-5 cm depth
Standard soil
GCR only
GCR + SCR
Time of Exposure (Myr)
Mass (amu)
0
200
400
600
800
1000
1200
1400
100
300
500

[illegible]

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12C/13C ratio

- Natural abundance: 12C ~99%; 13C ~1%
- Ratio important for identification of the source of organic matter
- Both 12C and 13C can be produced in spallogenic reactions on 16O
- Long exposure would cause “heavy” organic matter

Conclusions

- Destruction of complex organic matter in the top 5-10 cm of soil by the ionizing radiation cannot be neglected if the age of exposure is > 200 Myr
- 12C/13C will become "heavy" due to production of 13C by the ionizing radiation in the soil if the total carbon content is in ppm range

Suggestions for the outcrop selection

- Seek outcropes with fresh (<100 Myr old craters) craters
- Seek outcropes with "high" erosion rates (~10 nm per year)
- SCRs effects can be effectively eliminated by choosing outcropes at lower elevations